Fixed-Exit Monochromator

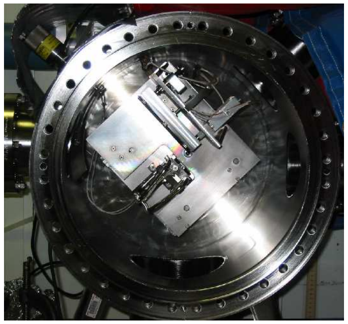
Beamline: X12A, X19A

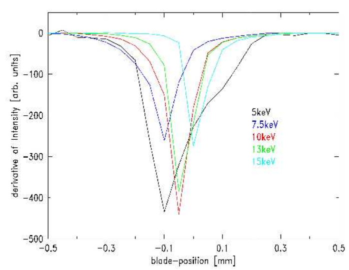
Technique: X-ray Optics Development

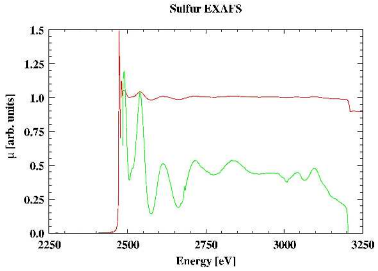
Researchers:
W.A. Caliebe, S. Cheung, A. Lenhard, D.P. Siddons (NSLS)

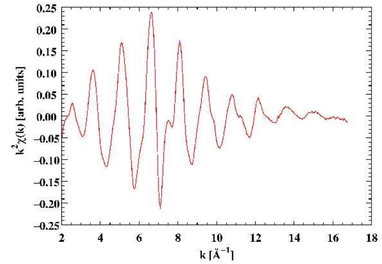
Publication:
W.A. Caliebe, S. Cheung, A. Lenhard, D.P. Siddons, Fixed-exit monochromator with fixed Rotation Axis, Proceedings of SRI2003

Motivation: Monochromators play a crucial part in synchrotron radiation beamlines. They are exposed to high-intensity radiation with significant power dose, that distorts the crystal if sufficient cooling is not provided. In order to keep the direction of the beam constant as a function of the angle between the x-rays and the crystal surface, two parallel crystals are used. The offset *h* of the monochromatic beam depends on the gap *D* between the two crystals and the angle Θ. For many experiments, it is important to keep the beam-position fixed, which requires to adjust the gap between the crystals for different angles.









(Top left) Picture of Monochromator inside its vacuum-vassel.(Top Right) Beamposition as function of energyl (bottom left) S K-edge, the spectral range is limited by experimental artifacts (bottom right) Co EXAFS

Results: The newly developed monochromator keeps the beam height fixed between 2.1 and 17keV with a simple cam. The cooling of the first crystal is efficient, i.e. the intensity of the monochromatic beam stabilizes within 5 minutes after the intense white beam hits the first crystal. Error analysis of the monochromator shows that misalignment of the set-up (wrong gap between the crystals, incident beam not parallel to cam) affects the beam height as $h'=h+2\delta\cos\Theta$ and $h'=h\cos(\Theta-\delta)/\cos\Theta$, where δ is the difference to the correct crystal gap and to the correct angle between the cam and the incident beam, respectively. Precision of 5µm and 50µrad result in translations of the beam of less than 10µm between 2.1 and 14keV for Si(111).